

Applying hierarchical autoregressive neural networks for three-dimensional Ising model

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3D Ising model

Autoregressive neural network:

$$q_{\theta}(s) = \prod_{i=1}^N q_{\theta}(s_i | s_1, s_2, \dots, s_{i-1})$$

Hierarchical structure:

$$p(s) = p(B(s))p(I(s)|B(s))$$

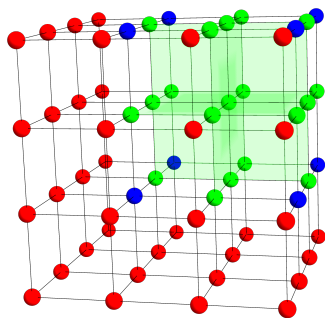


Figure: Scheme of hierarchical decomposition of $4 \times 4 \times 4$ cube

Neural Importance Sampling:

$$Z = \frac{1}{N} \sum_{i=1}^N \frac{e^{-\beta E(s_i)}}{q_{\theta}(s_i)}$$

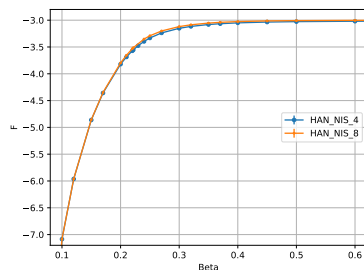


Figure: Free energy of β for HAN neural network